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COMPOSITION OF ROCK CORE FROM HOLE AEC-8, NEW MEXICO.(U)
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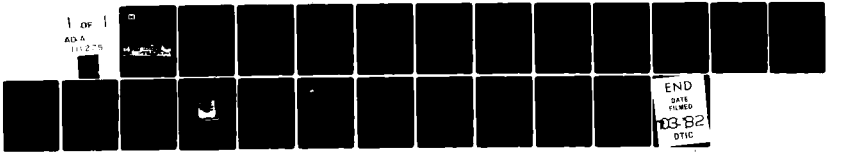

MISCELLANEOUS PAPER SL-81-34

COMPOSITION OF ROCK CORE FROM HOLE AEC-8, NEW MEXICO

by

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December 1981
Final Report

Prepared for Sandia National Laboratories
Albuquerque, N. Mex. 87115
and
Office of Nuclear Waste Isolation
Battelle Memorial Institute
Columbus, Ohio 43201

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Miscellaneous Paper SL-81-34	2. GOVT ACCESSION NO. AD-A111 275	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) COMPOSITION OF ROCK CORE FROM HOLE AEC-8, NEW MEXICO		5. TYPE OF REPORT & PERIOD COVERED Final report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Jay E. Rhoderick Alan D. Buck		8. CONTRACT OR GRANT NUMBER(s) U. S. Department of Energy Contract No. DE-AI97-81ET46633
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Structures Laboratory P. O. Box 631, Vicksburg, Miss. 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Department of Energy 505 King Avenue Columbus, Ohio 43201		12. REPORT DATE December 1981 13. NUMBER OF PAGES 18
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Sandia National Laboratories Albuquerque, N. Mex. 87115 and Office of Nuclear Waste Isolation Battelle Memorial Institute, Columbus, Ohio 43201		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

AEC-8 is a borehole about 5000 ft deep located within the Waste Isolation Pilot Plant (WIPP) site in southeastern New Mexico.

About 28 ft of rock core from seven depth intervals in this hole was characterized by petrographic examination. This included logging, examination of the rock with a stereomicroscope, examination of thin sections with a polarizing microscope, and examination of each sample by X-ray diffraction.

(Continued)

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20. ABSTRACT (Continued).

The following rock types were identifed:

Rock Type	Depth, ft
Reddish sandstone	57.6 to 63.0
Reddish silty claystone	560.4 to 563.2; 614.0 to 617.1
Impure grayish anhydrite	684.0 to 686.8
Grayish gypsiferous dolomite	733.6 to 734.0
Brownish siltstone	972.4 to 975.2
Colorless to reddish halite	1001.7 to 1007.2

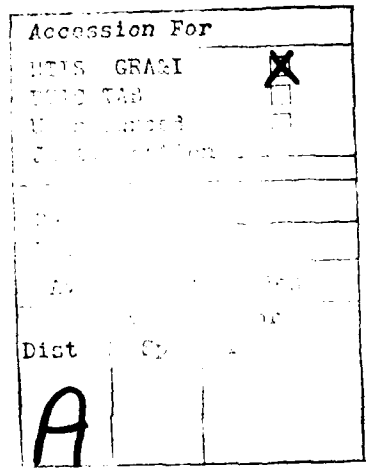
PREFACE

The work described herein was started for Sandia National Laboratories; it was completed under U. S. Department of Energy Interagency Agreement DE-AI97-81ET46633, Modification A001, subject "Investigation of Composition and Properties of Cementitious Mixtures for Boreholes and Shafts."

Mr. Floyd L. Burns of the Battelle Office of Nuclear Waste Isolation in Columbus, Ohio, was Project Manager during the completion of this work.

The work was done in the Structures Laboratory (SL) of the U. S. Army Engineer Waterways Experiment Station (WES) under the general supervision of Mr. Bryant Mather, Laboratory Chief; and Mr. John M. Scanlon, Jr., Chief, Concrete Technology Division. Mrs. Katharine Mather and Mr. John A. Boa, Jr., were Project Leaders in the SL. Mr. Donald M. Walley provided the samples. Messrs. J. E. Rhoderick and A. D. Buck examined the samples and prepared this report.

The Commanders and Directors of WES during this time were COL N. P. Conover, CE, and COL Tilford C. Creel, CE. Mr. F. R. Brown was Technical Director.



CONTENTS

CONVERSION FACTORS, NON-SI TO METRIC (SI)
UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
Fahrenheit degrees	5/9	Celsius degrees or Kelvins*
feet	0.3048	metres
inches	25.4	millimetres
angstroms	0.1	nanometres

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

COMPOSITION OF ROCK CORE FROM HOLE AEC-8, NEW MEXICO

PART I: INTRODUCTION

1. Several exploratory holes have been drilled in and around the Los Medanos site in southeastern New Mexico in connection with nuclear waste isolation. Hole AEC-8, located in Township 22 South, Range 31 East, Section 11, is one of these exploratory holes. AEC-8 was drilled to a depth of 3019 ft in 1974 and deepened to 4910 ft in 1976. Several hydrologic tests were made in it between 1976 and 1977.[1] Rock cores from AEC-8 were received at the U. S. Army Engineer Waterways Experiment Station (WES), Structures Laboratory (SL), on 29 January 1980. These cores will be used for tests of compatibility with grouts.

PART II: SAMPLES

2. A petrographic examination of 4-in.-diameter core from hole AEC-8 was requested in February 1981. It was from several depths and was packed in eight core boxes, each about 3 ft long. One other piece of core was also examined. Depth data are given below:

Depth, ft		
57.6	to	60.4
60.4	to	63.0
560.4	to	563.2
614.0	to	617.1
684.0	to	686.8
733.6	to	734.0*
972.4	to	975.2
1001.7	to	1004.4
1004.4	to	1007.2

* This was a sample supplied by C. Gulick of Sandia National Laboratories in 1980 from the Magenta Dolomite Formation, also hole AEC-8.

PART III: EXPERIMENTAL

3. Since no drilling log was received, each piece of core was logged. A stereomicroscope was used as needed to assist in this operation. Diagnostic features were noted, and the cores were then separated into rock types.

4. Three samples of the nonhomogeneous core from 733.6 to 734.0 ft and single samples of the other rock types, except the halite, were ground to pass a 45-μm (No. 325) sieve and examined by X-ray diffraction.

5. A 25-g sample from each of the four samples that exhibited a 14-Å clay peak was taken, ground but not sieved, and added to 500 ml of distilled water, and agitated for 5 min in a blender. The slurry was then poured into a 1000-ml beaker and filled with distilled water. The settling behavior was observed and determined as normal or abnormal. If it was abnormal, a dispersing agent was added and the sample was again agitated. When the settling was normal, the sample was left for 4 hr. The top 1-1/2 in. to 1-3/4 in. of the slurry was then siphoned off into an 800-ml beaker. This depth contained clay smaller than 2 μm e.s.d.* from the sample. The 800-ml beaker was filled with distilled water and stirred. Glass slides were suspended 2 to 3 in. below the surface of the water and left overnight. The water was then siphoned off to below the level of the slides. The sedimented slides were removed and allowed to dry. The air-dried slides were examined by X-ray diffraction. In addition, one sedimented slide of each sample was examined after glycerol treatment and another slide after heat treatment at 350° C for 1 to 3 hr.

6. The fine-grained reddish rock from the 560.4- to 563.2-ft interval contained scattered small patches of transparent material; some of this transparent material was hand-picked, ground, and examined by X-ray diffraction.

7. The rock from below 1000 ft was soluble. A sample of it was dissolved in distilled water; this water was placed on a glass slide to dry. The insoluble residue from the sample was ground to pass a 45-μm (No. 325) sieve. Both samples were examined by X-ray diffraction.

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* Equivalent spherical diameter.

8. All X-ray diffraction patterns were made with an X-ray diffractometer using nickel-filtered copper radiation.

9. Thin sections of each rock type except the soluble rock were made and examined using a petrographic microscope.

PART IV: RESULTS

10. The logs of the preliminary examination of the cores are shown in Figures 2 through 7. Figure 1 is a photograph of the section from 733.6 to 734.0 ft.

11. The core from 57.6 ft to 63.0 ft (two core boxes) was a fine-grained[2] moderate reddish brown (10 R 4/6)[3] sandstone. The major constituent was quartz. Minor constituents included salt (NaCl), feldspars, calcite, kaolinite, smectite,* chlorite, clay-mica,** and hematite, which produced the red coloring. Core from 57.6 to 60.0 ft exhibited little fracturing while there was much fracturing from 60.0 ft to 63.0 ft. The rock was very friable (Figure 2).

12. The core from 560.4 ft to 563.2 ft was a fine-grained[2] moderate reddish orange (10 R 6/6)[3] to pale reddish brown (10 R 5/4)[3] soft silty claystone. The silt was largely dolomite and quartz; the clay was kaolinite, smectite, chlorite, and clay-mica. Since the smectite showed X-ray diffraction peaks at 14 and 12 A in its as-received condition, it was a mixture of types with divalent and monovalent cations. The other fine material was largely hematite. The transparent patches were mainly gypsum with minor amounts of clay. Small spherical gray areas of the same rock were present within this reddish rock but did not show iron coloring (Figure 3). The rock from 614.0 to 617.1 ft was not examined by X-ray diffraction or as a thin section but appeared to be the same reddish rock. There was more fracturing of the rock from the 560.4- to 563.2-ft interval than from 614.0 to 617.1 ft.

13. Rock from 684.0 ft to 686.8 ft was fine-grained[2] light olive gray (5 Y 5/1)[3] anhydrite with some dolomite and quartz. This rock was massive with very little fracturing. Red coloring was present in some but not all of this footage (Figure 4).

14. The piece of core from 733.6 ft to 734.0 ft varied in composition over its length (Figure 1). The rock generally was a fine-grained[2] very pale orange (10 YR 8/2)[3] to grayish orange pink (5 YR 7/2)[3]

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* Swelling clay; the montmorillonite-saponite group.
** Clay-sized mica or illite or both; all with 10-A peak.

gypsiferous dolomite. The percentages of dolomite and gypsum ranged in the rock between 55 to 80 percent dolomite to 10 to 30 percent gypsum and 10 to 15 percent quartz as estimated in a thin section and by X-ray diffraction. Gypsum seemed to be concentrated on planes of bedding. Minor constituents included salt, sylvite, a mixed-layered clay (chlorite-smectite),* kaolinite, hematite, and clay-mica. Black seams parallel to bedding were visible between 733.9 ft and 734.0 ft (Figure 1, Figure 5).

15. Core from 972.4 ft to 975.2 ft was an olive gray (5 Y 4/1)[3] soft clayey siltstone consisting mainly of quartz. Other constituents included feldspar, dolomite, and possibly magnesite, salt, anhydrite, kaolinite, a regularly mixed-layered clay (chlorite-smectite), chlorite, and clay-mica. Shale seams normal and parallel to bedding were present. Salt crystals were visible along bedding planes (Figure 6).

16. Rock from 1001.7 ft to 1007.2 ft (two boxes) was highly soluble, moderate reddish orange (10 R 6/6)[3] massive salt with minor amounts of anhydrite and clay-mica. Iron staining was visible in most of the core. Some fracturing of the salt was evident (Figure 7).

17. No direct comparison between these mineralogical identifications and those in Reference 1 was possible since all of those data by depth (Vol 2, Appendix 7, pp 11 through 16) were below those in the present report. The variability of material from this hole is suggested by the fact that the piece of Magenta Dolomite examined here (733.6 to 734.0 ft) contained a lot of gypsum with the dolomite while it is described on page 4 of Appendix 7 in Vol 2 of Reference 1 as "largely ferroan dolomite, probably containing minor ankerite which gives rise to the reddish color in weathered outcrops. This rock also contains detrital quartz, and gypsum forms as crystals, filling the vugs in the dolomite, which can be up to several cm across." This was a comment in the reference and no depths were specified. However, the sample examined at Sandia National Laboratories as described appeared to contain more dolomite than this sample from a depth of 733.6 to 734.0 ft.

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* Largest air-dry basal spacing was about 29.4 Å.

PART V: SUMMARY

18. Samples of core from seven depth intervals in hole AEC-8 were examined; the depths ranged from 57.6 to 1007.2 ft and totaled about 28 ft. All of the rock was sedimentary and included sandstone, claystone, siltstone, anhydrite, gypsiferous dolomite (Magenta Dolomite Formation), and salt (halite). Minerals commonly present included quartz, dolomite, anhydrite, gypsum, salt, and clays.

19. The rock types as identified by depth are listed below:

Depth, ft	Rock Type
57.6 to 63.0	Sandstone
560.4 to 563.2,	Silty claystone
614.0 to 617.1	Silty claystone
684.0 to 686.8	Anhydrite with some dolomite
733.6 to 734.0	Gypsiferous dolomite
972.4 to 975.2	Siltstone
1001.7 to 1007.2	Halite

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3. The Rock Color Chart Committee, E. N. Goddard, Chm., "Rock-Color Chart," 1975, The Geological Society of America, Boulder, Colo.

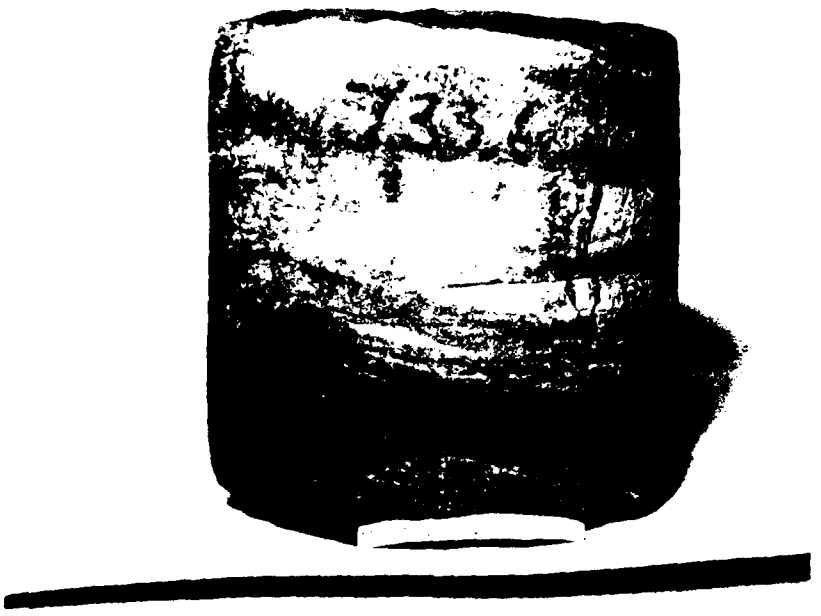


Figure 1. Core from 733.6 ft to 734.0 ft showing filled fractures both parallel and normal to the bedding plane, and color changes from dark to light

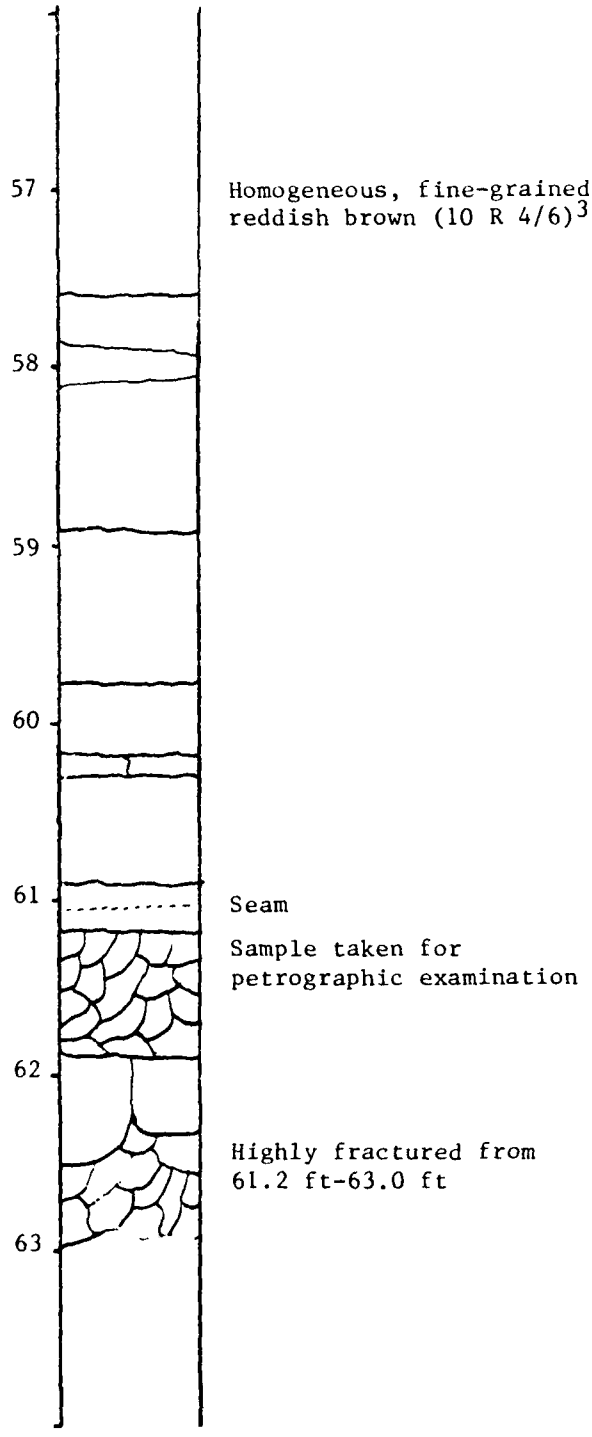
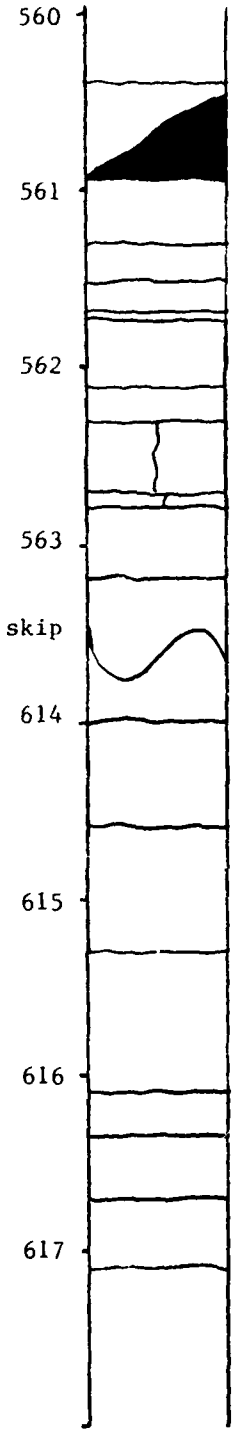


Figure 2. Rock core from 57.6 to 60.4 and 60.4 to 63.0 ft



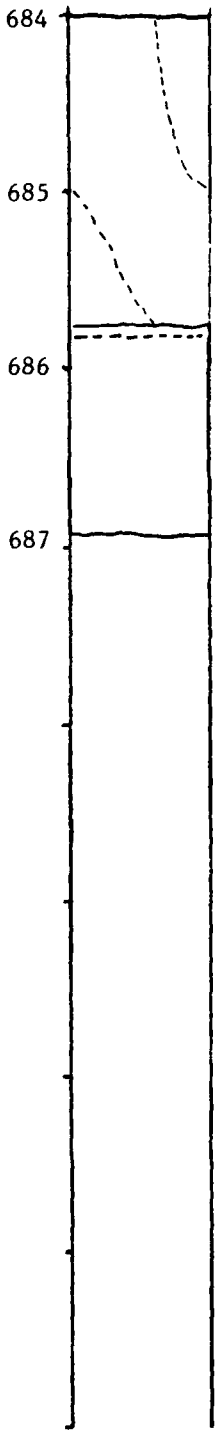
Rock is soft silty claystone that is moderate reddish orange (10 R 6/6)[3] (560.4 to 563.2 ft) and pale reddish brown (10 R 5/4)[3] (614.0 to 617.1 ft).

Some plastic deformation along bedding.

Larger grain size, distinct bedding.

More fracturing in upper portion.

Figure 3. Rock core from 560.4 to 563.2 ft and 614.0 to 617.1 ft

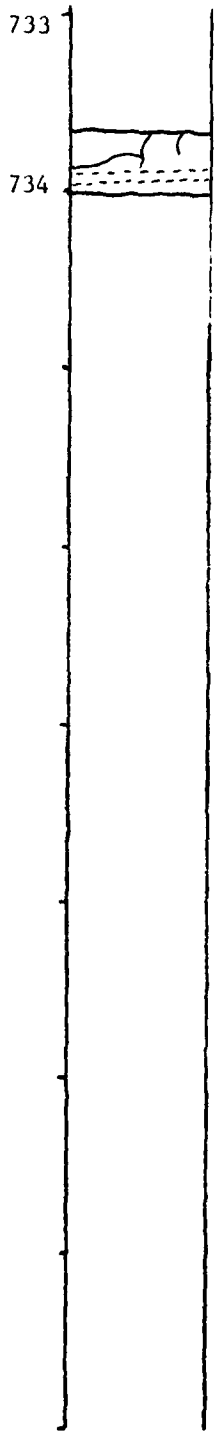


Homogeneous, massive, fine-grained anhydrite.

Some cracking 60° from normal.
Light olive gray (5 Y 5/1)[3]

Sample taken for petrographic examination.

Figure 4. Rock core from 684.0 to 686.8 ft



Fine-grained, gypsiferous dolomite rock.
Pale orange (10 YR 8/2)[3] to grayish orange pink (5 YR 7/2)[3]

Filled fractures approximately normal and parallel bedding.
Shale seams parallel to bedding.

Figure 5. Rock core from 733.6 to 734.0 ft

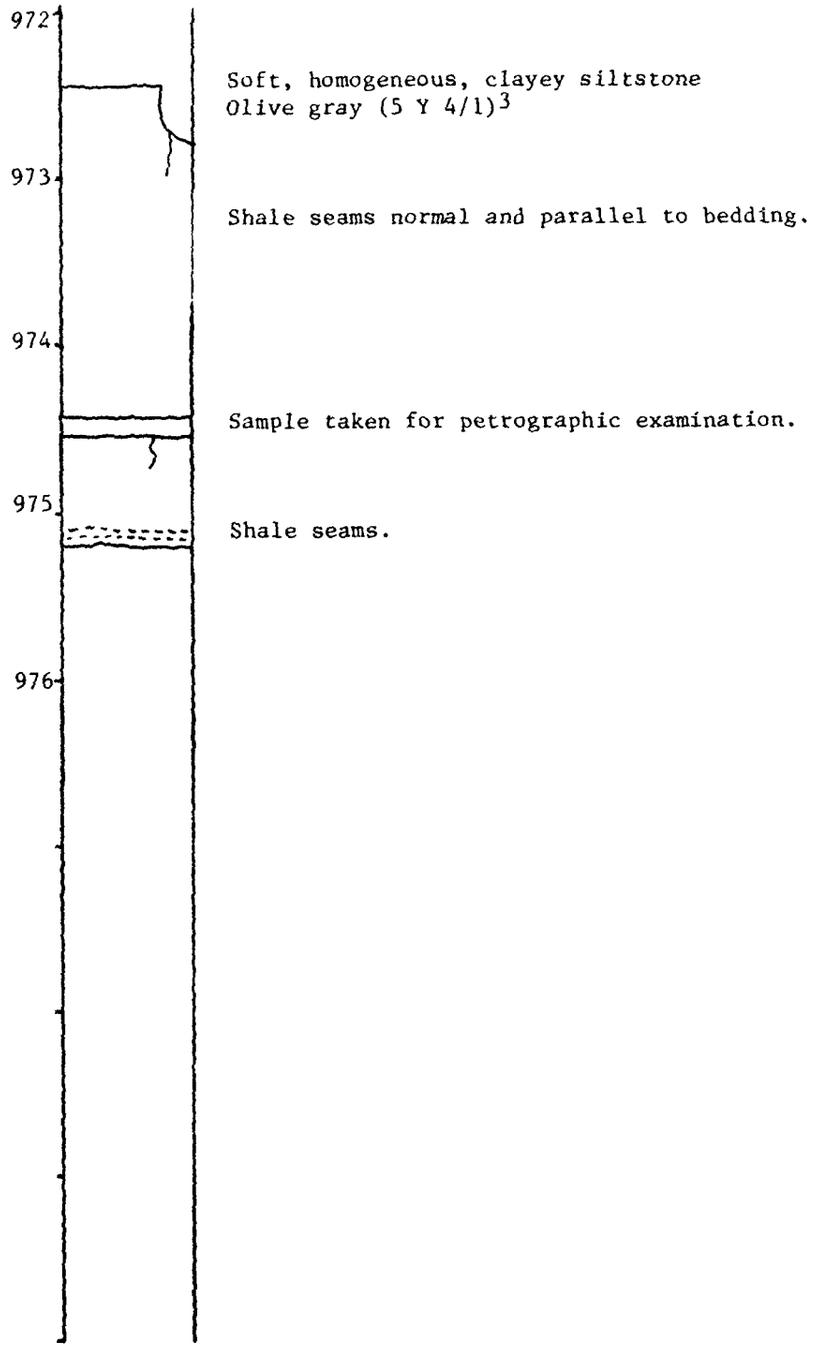


Figure 6. Rock core from 972.4 to 975.2 ft

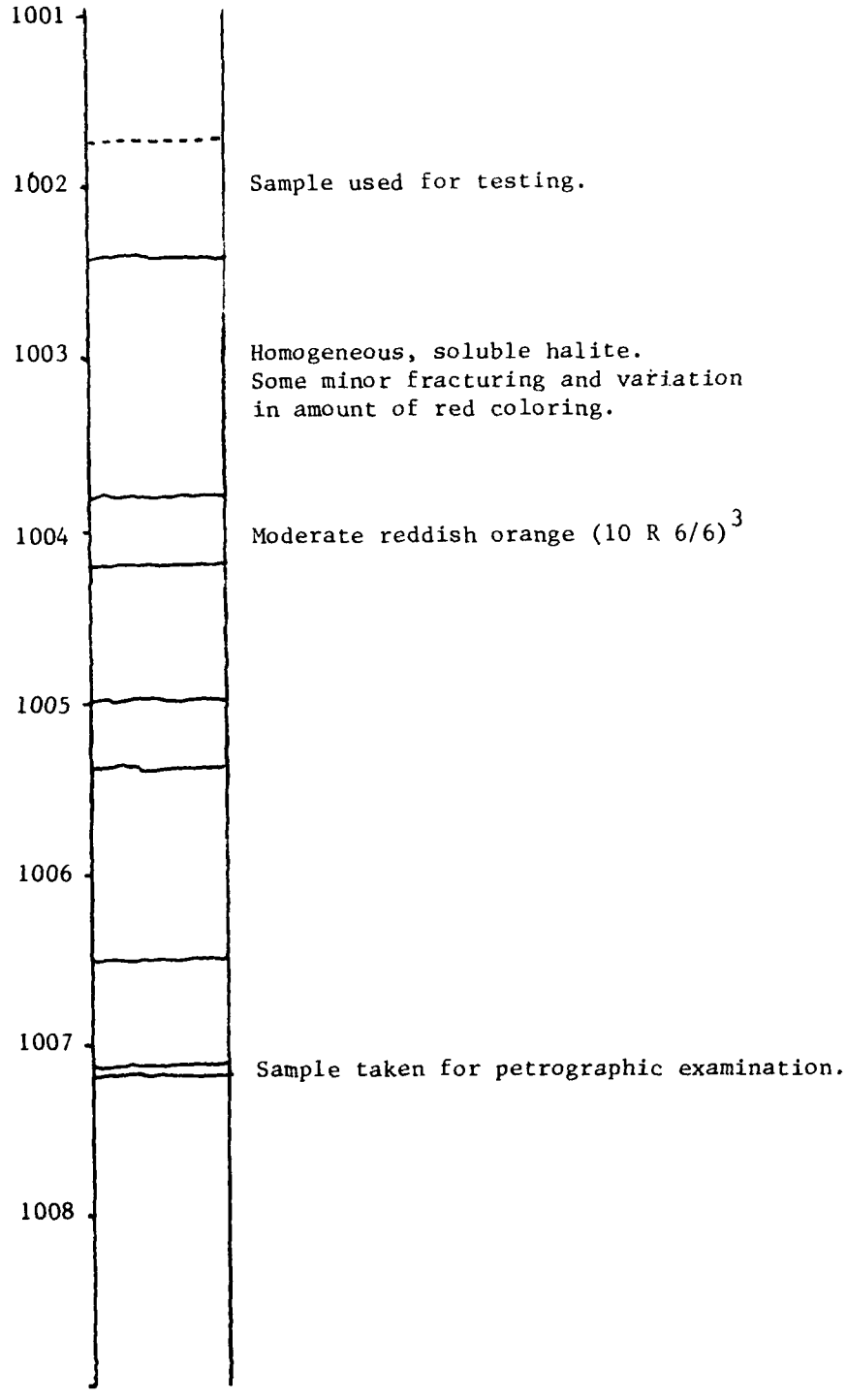


Figure 7. Rock core from 1001.7 to 1007.2 ft

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Rhoderick, Jay E.
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18 p. : ill. ; 27 cm. -- (Miscellaneous paper ; SL-81-34)
Cover title.
"December 1981."
Final report.
"Prepared for Sandia National Laboratories and Office of Nuclear Waste Isolation."
Bibliography: p. 11.

1. Boring. 2. Core drilling. 3. Rock-drills. I. Buck, Alan D. II. Sandia National Laboratories. III. Battelle Memorial Institute. Office of Nuclear Waste Isolation. IV. U.S. Army Engineer Waterways

Rhoderick, Jay E.
Composition of rock core from hole AEC-8 : ... 1981.
(Card 2)

Experiment Station. Structures Laboratory.
V. Title VI. Series: Miscellaneous paper (U.S. Army Engineer Waterways Experiment Station) ; SL-81-34.
TA7.W34m no.SL-81-34

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